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# Unmanned Systems Sentinel / 13 April 2016

Naval Postgraduate School (U.S.)

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## **Unmanned Systems Sentinel**

**All opinions expressed within this newsletter are those of the respective author or authors and do not represent the official policy or positions of the Naval Postgraduate School, the United States Navy, or any other government entity.**

Thanks to Robin Alexander and Mark Rindler for providing several of the below articles. 13 APR 2016

Please keep in mind that in most instances the below summaries are excerpts from the original article. The full articles can be viewed at the accompanying hyper-links. The inclusion of these links does not represent an endorsement of the organization, service, or product. Immediately below are this edition's highlights with links to the respective articles:

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### **UPCOMING EVENTS:**

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### **NAVY/USMC:**

#### **Cubic's Advanced Data Link Solutions Integrated into Northrop Grumman's MQ-8C Fire Scout Wide Band Line of Sight**

SAN DIEGO--Cubic Global Defense, a business unit of Cubic Corporation, announced that a Cubic designed and produced Wide Band Line of Sight (WBLOS) data link system integrated into Northrop Grumman Corporation MQ-8C Fire Scout recently completed a successful operational assessment.

Fire Scout is a combat proven, unmanned helicopter system that provides real-time Intelligence, Surveillance and Reconnaissance (ISR), target-acquisition, laser designation and battle management to tactical users without relying on manned aircraft or space-based assets. The MQ-8C Fire Scout is the U.S. Navy's next-generation unmanned helicopter.

Cubic is the provider of the data link system for the MQ-8C Fire Scout, in which two Cubic Miniature Multi-band Transceivers (MMT) enable simultaneous Ku Band transmissions. Cubic's MMT is a fast, compact, software defined radio that is fully programmable and can be used with a standard, bandwidth-efficient Common Data Link (CDL), and other waveforms. To support the MQ-8C program, Cubic has delivered more than 20 units in production and spares to date.

"Cubic provides compact, secure wide-band communications and networking solutions for use on manned/unmanned platforms," said Mike Twyman, executive vice president, Communications, Intelligence and Surveillance Systems of Cubic Global Defense. "The successful completion of the

operational assessment of MQ-8C Fire Scout is a testament to our strong working partnership with Northrop Grumman.”

“Cubic data link is essential to the MQ-8C Fire Scout and was vital to the successful completion of the operational assessment,” said Leslie Smith, vice president for medium-range tactical systems at Northrop Grumman. “We value the partnership and outstanding performance of the communication systems provided by Cubic in support of the Fire Scout.”

MQ-8C Fire Scout completed the developmental flight test program for the MQ-8C in 2015 and preparations are underway for the next assessment milestone this year.

<http://www.businesswire.com/news/home/20160405005225/en/Cubic%E2%80%99s-Advanced-Data-Link-Solutions-Integrated-Northrop>

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### **US Navy's solar drone flies from and lands on water - Aqua-Quad**

Unlike most quad-copters, the Aqua-Quad doesn't take off from solid ground. Dr. Kevin Jones and his team from the Naval Postgraduate School developed it to fly straight up from the ocean or any body of water. And it can land back on water after it has fulfilled its mission, staying on or under the surface until it's deployed again. According to New Scientist, the Aqua-Quad (PDF) could be used to replace sonobuoys to search for submarines, especially enemy subs that might be lurking in the depths of the country's oceans.

They're even better than the actual expendable sonar systems, because they're not constrained by battery life: the drone's rotors are covered in solar cells and can generate power after a little time under the sun. In addition, it can hunt for subs in flocks in case the Navy wants to scour a big area more quickly. Jones told the publication that as a sonobuoy replacement, the drone "[will] be on the water 23 hours a day, and flying maybe one hour a day." It was designed as a "launch and forget" system with a water-tight enclosure, though, so we're guessing it's tough enough to endure the ocean's harsh conditions.

Speaking of drones that can take off from water, researchers from the Johns Hopkins University Applied Physics Laboratory created a similar machine called CRACUNS. It can stay hundreds of feet underwater for months at a time until its operator sends it out to do his bidding.

<http://www.engadget.com/2016/04/07/us-navy-solar-aqua-quad-drone/>

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### **RMMV, CUSV, Knifefish Will All Play a Role in LCS Mine-hunting**

WASHINGTON, D.C. – The Navy will rotate three different unmanned vehicles into its Littoral Combat Ship mine countermeasures mission package to fill a primary mine-hunting role, rather than competing the three vehicles as the service previously announced.

When it became clear the Remote Multi-mission Vehicle (RMMV) could not meet reliability requirements last summer – the vehicle was only reaching about 40 hours mean time between operational failure instead of the required 75 – the Navy paused testing on the MCM mission package until it could decide on a new path forward.

In February the Office of the Assistant Secretary of the Navy for Research, Development and Acquisition (ASN RDA) said the Navy would “evaluate and compete three capabilities to perform the volume and bottom mine-hunting function”: an upgraded Lockheed Martin RMMV towing the mission package’s AN/AQS-20A sonar; the Textron Common Unmanned Surface Vehicle (CUSV), which will tow a minesweeper in a later increment of the mission package, towing the AQS-20A sonar; and the General Dynamics Knifefish unmanned underwater vehicle, which will hunt for buried and high-clutter mines in a later increment, using its built-in sonar.

However, after an April 6 Senate Armed Services Committee hearing, ASN RDA Sean Stackley told reporters that all three systems would be used as the Navy incrementally improves the mission package.

“I wouldn’t call it a competition,” he said. “I don’t see them as competing, I see it as an incremental approach: what we’ve got today for near-term, what we see as a mid-term, but where we ultimately want to get to is a single unmanned vehicle” that doesn’t have to tow its sensor package.

Stackley explained that the rest of the MCM mission package works fine, but that the RMMV – despite going into a Reliability Growth Program in 2011 to get up to the 75-hour requirement – couldn’t get past the 40-hour mark. The growth program produced several solutions, but not all can be back-fitted onto existing vehicles. Therefore, the Navy would have to build new vehicles and then start testing over to see if the improved vehicles actually achieved the reliability requirement – about a three-year process with a cost of about \$15 million per vehicle, he said.

“That’s a significant investment, a three-year period of time, and [does] not close the loop in terms of certainty that we’re going to pass,” he said.

Instead, the Navy will upgrade the 10 RMMVs it already owns and field them around 2018, “because that’s better than what we’ve got out there today (with legacy MCM systems), so we’ll have an operational capability that doesn’t fully meet our requirements.”

The littoral combat ship USS Independence (LCS-2) deploys a remote multi-mission vehicle (RMMV) while testing the ship’s mine countermeasures mission package (MCM) off the southern California coast in August 2013. Austal USA Photo

The littoral combat ship USS Independence (LCS-2) deploys a remote multi-mission vehicle (RMMV) while testing the ship’s mine countermeasures mission package (MCM) off the southern California coast in August 2013. Austal USA Photo

In parallel, the Navy expects to receive its Common Unmanned Surface Vehicle (CUSV) this August and will begin testing it to see if it can tow the AQS-20A sonar. In 2011, prior to sending the RMMV into the reliability growth program, the Navy considered ditching that vehicle in favor of using an unmanned surface vehicle to tow the sonar – but at the time the movement of the unmanned vehicle on the water’s surface rendered the sonar inaccurate, Stackley said. Today, software exists to correct for the movement of the unmanned vehicle, and isolation devices can minimize how much the bobbing CUSV actually moves the towed sensor.

Stackley said the CUSV costs a third of the RMMV, coming in at \$5 or \$6 million apiece, and testing can begin this summer. The Navy wouldn’t be ready for initial operational test and evaluation until 2020, however, and so the upgraded RMMVs will fill the volume and bottom minehunting role for two years until the CUSV could take over, he said.

Finally, he said, the smaller Knifefish vehicle has performed well in testing but does not have enough endurance to cover large minefields.

“Knifefish ... doesn’t have the legs that the RMMV has. RMMV is a truck, you put that thing out in the water and it just goes goes goes. It’s got long endurance,” Stackley said.

“Well the Knifefish doesn’t have the same degree of endurance. So for certain mine countermeasure missions, it’s actually better than the RMMV, but for long endurance ... we need to up the endurance on Knifefish.

“If we succeed in getting the endurance that we need out of Knifefish, now you have further simplified the mine countermeasures mission package because now you don’t have a vehicle towing a sensor, now you have a sensor embedded in a vehicle,” Stackley continued. In that case, the CUSV would remain in the mission package to tow the influence sweep system only.

“If a version of Knifefish, if we can get that to provide the degree of endurance that we need, we will probably end up buying more of those,” Stackley said.

“I don’t know about CUSV, we haven’t done the analysis yet. Because we’re already going to have CUSV as part of the mission package, what we’re going to have to do in the analysis is determine, since we’re going to be multitasking the vehicle, we have to look at the various [concepts of operations].”

Vice Adm. Joseph Mulloy, deputy chief of naval operations for integration of capabilities and resources, added that it was still unclear if a single CUSV could tow a sweep and a sonar in the same run or if two separate vehicles would have to conduct two separate missions in the same minefield. He said he hoped to complete that analysis in time to inform the Fiscal Year 2018 budget request – by about this fall – though he acknowledged this was a tight timeline given all the other moving pieces in the LCS MCM mission package.

Mulloy also added that the FY 2017 budget requests includes \$634 million for unmanned underwater vehicles, some of which will fund research on improved power and energy systems that will increase the endurance and reach of all UUVs in the fleet.

<https://news.usni.org/2016/04/07/stackley-rmmv-cusv-knifefish-will-all-play-a-role-in-lcs-minehunting-not-a-competition>

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## **Unmanned Sub-Hunter to Begin Test Program**

WASHINGTON — The cat-and-mouse game of anti-submarine warfare (ASW) is always characterized by endurance. How long can a crew hold out? How long can a pursuer stay on top? If it's a non-nuclear sub, how long can the undersea boat's engines keep running?

*Enter the unmanned vessel – still restricted by fuel, but unconstrained by the need to support human operators.* While small unmanned surface and underwater vehicles have been around for decades, the US Navy is taking a significant leap forward with the development of the Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV), a 132-foot long vessel intended to search for submarines at sea as long as three months at a time.

ACTUV — pronounced “active” — “is focused on providing a high degree of autonomy,” program manager Scott Littlefield told reporters Wednesday. “It's not just a remote controlled boat.”

Computers will drive and control the ship, Littlefield said, but a human will always be observing, able to take charge if necessary. The concept, called Sparse Supervisory Control, means “the human being is in control, but not joy sticking the vessel around,” Littlefield said.

Prime contractor for the Defense Advanced Research Projects Agency (DARPA) ACTUV program is Leidos, and construction took place at the Vigor Shipyard in Portland, Oregon. Until a merger in 2014, the yard was known as the Oregon Iron Works, specializing in the design and construction of exotic special-mission craft.

Launched in January, the ACTUV vessel, named Sea Hunter, has been running trials in the Portland area. The vessel was commissioned today in a ceremony at Portland, and in a couple weeks will be sent to San Diego, where DARPA and the Office of Naval Research (ONR) will begin a two-year-long trial period to test the concept and various sensors that can be installed on the 145-ton full load displacement vessel. DARPA will conduct the initial trials and turn the vessel over to ONR later this year. The test phase will run through September 2018.

Sea Hunter will carry about 40 tons of fuel. Top speed on trials was around 27 knots, Littlefield said, although the actual top speed is dependent on the sea state and how much fuel is on board. The vessel is intended to be operational through Sea State 5 – moderate waves up to about 6 and a half feet high and winds up to 21 knots — and be survivable through Sea State 7, considered to be rough weather with seas up to 20 feet high.

The configuration of the composite-construction design resembles a Polynesian war canoe, with a long, slim hull supported by outboard pontoons — called Amas — connected by outriggers. The composite



hull features a foam core with a fiberglass skin, Littlefield said, while the outriggers are fabricated with higher stiffness.

Sea Hunter will not carry weapons, but will trail sensors designed to detect and track submarines. The vessel, Littlefield said, could operate with Littoral Combat Ships, in essence becoming an extension of the LCS ASW module.

A removable operator control station is installed on the craft, and a person will be on board throughout the test period, "for safety and backup," Littlefield said. "We'll be there for a while until we work through the reliability question."

Like most DARPA projects, the Sea Hunter is not a prototype for an operational Navy platform, although it could be. The overall goal, Littlefield said, is "to build something very affordable which could probably be acquired in large numbers."

As the first hull, Sea Hunter is a bit more pricey than a potential follow-on vessel.

"It looks we're going to deliver the first one for a construction cost of between \$22 million and \$23 million dollars," Littlefield said. "We're trying to get to a series cost of about \$20 million a copy — not cheap, but not as expensive as a manned warship." The daily operating cost is likely to be between \$15,000 and \$20,000, he added.

The cost figures do not include program costs, including development, design and software.

<http://www.defensenews.com/story/defense-news/2016/04/07/darpa-actuv-sea-hunter-test-antisubmarine-warfare-asw-drone-unmanned-vigor-portland-onr-naval-research/82744862/>

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## **ARMY:**

### **APG Testing 3-D Printing to Help Arm U.S. Military**

Say you're a soldier sent on a mission into hostile territory. You'd like to have a drone to keep an eye out for ambushes. Maybe there's one on hand, but it's not quite right for the job. Or maybe there's nothing available at all.

Researchers at Aberdeen Proving Ground want to help, and they think 3-D printing is the answer.

By giving soldiers kits of electronic parts, and equipping bases with the printers, they envision a future in which troops in the field could build their own drones in a matter of hours.

It's already possible to print a drone in a day. Eric Spero, an engineer at the Army Research Laboratory, said the approach would enable units in the field to adapt on the go.

"Going from nothing to a flying vehicle within 24 hours is pretty amazing," Spero said.

The 3-D-printed drone is just one example of how the emerging manufacturing technology is letting commanders rethink how they equip troops. Officials hope that printing gear will give front-line fighters more say in the equipment they carry, make it easier and far cheaper to repair aging vehicles, and minimize the impact when enemies cut supply lines.

And by enabling the military to make what it needs in-house, the technology also has the potential to reshape the relationship between defense contractors and the government.

Navy Capt. Frank Futch, who is working to make 3-D printing widely available to sailors, foresees systems deployed on ships around the world, churning out parts on demand.

"It's transformative," he said. "We need to stay ahead of the curve and figure out how we're going to implement this as quickly as possible."

The technology can cut both ways. While there is interest across the military in the potential for printing, its adoption by America's enemies and rivals could present major challenges.

Retired Marine Col. T.X. Hammes, a researcher at the National Defense University, said the combination of 3-D printing and other technologies, such as cheap cellphones and more powerful explosives, could cut into the advantage offered by fighter jets or submarines that cost tens or hundreds of millions of dollars.

"All of these things are coming together very, very quickly, and that changes power structures," Hammes said.

In a recent paper, Hammes said a 3-D printing plant could cheaply churn out tens of thousands of drones a day, which could be used as flying bombs guided by cellphones to strike U.S. aircraft sitting on runways. The printers would not only build the drones, but make it much easier to manufacture a key component used in improvised explosive devices.

"It shifts the power," he said. "How do you protect every airfield in the world?"

The ability to print objects in three dimensions – more properly called additive manufacturing – has been around since the 1980s. But patents have expired in recent years, unleashing a wave of innovation.

Commercial printers, available for a few hundred dollars each, squirt hot plastic layer by layer to build up an object.

"Think of it as building a loaf of bread one slice at a time," said Brad Ruprecht, a technician at the Edgewood Chemical Biological Center at Aberdeen Proving Ground.

In a space once used to teach soldiers how to maintain vehicles, Ruprecht oversees a collection of large and much more sophisticated 3-D printers.

In one room, there's a machine that works like an inkjet printer. It can print in several shapes and materials at once. It uses ultraviolet light to turn liquids solid, forming layers much thinner than a human hair. Last week, its printing head moved back and forth as a gas-mask emerged beneath.

A machine nearby used lasers to turn powdered nylon into strong bars of solid plastic. Motors whined as mirrors fluttered backward and forward to guide the laser melting the plastic. A roller pushed a fresh layer of powder over the top, before the laser made another pass.

Elsewhere, a pair of machines shot laser beams into a pool of plastic goo, turning liquid into solid parts for a model vehicle.

The engineers at the Edgewood Chemical Biological Center have had access to the printers for decades, but branch chief Rick Moore said demand for the quick turnaround jobs for which the machines are suited has boomed in recent years.

"After 9/11, things changed and we had our hands in a lot of different projects," he said.

The Edgewood team used 3-D printing to help build a system to destroy a stockpile of chemical weapons in Syria, to make a prototype kit for detecting bomb-making materials that is now being used in the field, and to design a gadget for reading medical test results.

The Navy has also been exploring the possibilities. Futchter said mobile labs are deployed on three ships, getting sailors used to the idea of designing their own parts. In one case, the Navy printed molds for metal filters to go on torpedo tubes. Before 3-D printing, they had been cannibalizing parts from decommissioned submarines.

Currently, the use of 3-D printing is limited mostly to the design phase of a new product or making spare parts. The printers in some cases are still slower than traditional manufacturing methods, the size of parts is limited by the size of the printer and the layering means the finished product can have weaknesses.

The Air Force has shown that some parts of a rocket engine can be printed. Researchers at the Johns Hopkins University are testing whether they perform as well as the components currently in use.

"We've got a little bit of figuring out to do," said Peter Zeender, a researcher at Hopkins' Whiting School of Engineering.

Defense industry analysts said 3-D printing is still a ways off from upending how the military shops. But contractors are thinking through the implications. Military officials and business leaders plan to meet this spring to figure out how the military would buy data to print urgently needed parts.

Mark Vitale, a consultant at Deloitte, which is to be involved in the session, described the underlying concept as "let's replace inventory with information."

The technology is growing more sophisticated. One approach that has Ruprecht and Moore excited would be much faster and essentially do away with the layers; another uses robotic arms to make much bigger parts. Engineers are looking at how 3-D printing can be used to make finished products.

Scott Thompson, an aerospace and defense expert at the consulting firm PwC, said the military will likely be able to design and build small systems on its own, but won't be able to cut contractors out completely.

Jason Phillips, a Navy engineer, recently designed and built a six-legged robot for a 3-D printathon, going from an initial design to finished prototype in just over a month. More than 90 percent of the foot-long bot was printed, he said, including moving parts and gears.

The creature attracted interest at the event. Phillips wants to continue work on the project, which he figures could be useful to Navy SEALs operating in hazardous environments.

"The best benefit of additive manufacturing is being able to test stuff," Phillips said. "You have a lot more freedom in what you're able to build."

Spero's team at Aberdeen Proving Ground has been selected to demonstrate its 3-D printed drones at an exercise next year. He said that showing their ideas to a wider audience should give team members a sense of how much interest there is among soldiers in having custom-built tools for specific missions.

David Sheffler, a researcher at the University of Virginia, is also working with the Army on printing drone parts. In 2014, his team demonstrated that it could print a drone that could be launched by hand and replicate the abilities of the RQ-11 Raven used by the Army.

"We're able to print these things at a ridiculously reduced cost," Sheffler said.

The Raven system costs \$173,000, according to the Air Force. Sheffler says his drone cost only \$2,500 and can be put together in about 36 hours. During most of that time, Sheffler said, he can be "sleeping, drinking coffee and watching TV" as the printer does its job.

The next step is to give the drone the ability to take off vertically; to be fully autonomous, so it can fly itself around the battlefield even if its connection to the GPS system is cut off; and to carry out precise landings – on the back of a Humvee, for example.

Sheffler says 3-D printing remains a long way from the manufacturing techniques now used to make planes. And in a video released by the university, his prototype crashed on launch several times. But he can always make another one without spending too much money; they are cheap enough to be considered almost disposable.

"You lose one of ours, you don't care," Sheffler said.

<http://www.baltimoresun.com/news/maryland/bs-md-3d-printing-military-20160401-story.html>

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## **Army wants drones to act as scouts for ground vehicles**

The Army is looking to develop an autonomous unmanned aerial system that can act as a kind of scout for ground vehicles, following the road in front of the vehicle at a fairly low altitude while matching the vehicle's speed, with the ability for ground crew to manually override the UAS controls when necessary.

It's still in the early stages, but in a sources sought notice issued this month, the Army said it is seeking white papers as well as capability demonstrations for an autonomous UAS navigation requirement. Such a system should be capable of demonstrating some or all six capabilities listed in the notice:

Fly a UAS ranging from stationary up to a ground speed of 7 miles per hour in advance of vehicle.

Fly at an altitude of nine to 98 feet and maintain a variable distance of zero to 196 feet in advance of a supporting ground vehicle.

Match the speed of a ground vehicle once positioned in advance of it.

Allow for manual override for investigating targets of interest whether the ground vehicles if moving or stationary.

Enable adjustments in speed, altitude and distance of the UAS in advance of a moving or stationary vehicle.

Be capable of following a road in advance of a vehicle moving over complex routes.

Interested responders must be prepared to demonstrate aforementioned capabilities and issue a final report describing technical approaches used during demonstration. The demonstration will either take place at a vendor's location or Quantico Marine Base between May 2016 and through September 2016.

The Army has invested significantly in UAS technologies in the past few years. A report issued by Govini recently discovered the Army, at its peak in 2012, represented 42 percent of the market procurement, with 200 RQ-7 Shadow purchases. Additionally, Army UAS contracts were the most lucrative among the service branches, with \$2.1 million being the average deal size.

The Army has also examined UAS operation in so-called GPS-degraded environments. "As GPS degraded environments become realized, the Gemini lab is on the forefront of understanding these threats and developing strategies to mitigate them," Virginia Overstreet, Army Aviation and Missile Research, Development and Engineering Center's Navigation Technology Function chief, said, referring to a laboratory established to "test, evaluate and overcome vulnerabilities of the MQ-1C Gray Eagle system." In addition to the internal research being done, the Army in October of 2015 issued a sources sought notice seeking the insight of industry to address this very issue. Ultimately, the program wants to expand the capabilities of GPS sensing and collaborating architectures in degraded environments. The service, however, has declined to offer additional details regarding this effort when prodded given the sensitive nature of the material.

Responses for the autonomous UAS navigation requirement notice is due May 19, 2016.

<https://defensesystems.com/articles/2016/04/08/army-autonomous-uas-ground-vehicle-support.aspx?m=1>

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## **USAF:**

### **Reaper Demand Drives Uptick in Air Force UAS Spending**

WASHINGTON — The Air Force edged out the Army as the leader in unmanned systems procurement in recent years, a shift driven in part by increasing demand for General Atomics' MQ-9 Reaper and Northrop Grumman's Global Hawk, according to a new study.

The uptick in Air Force spending on unmanned aerial systems, or UAS, is part of a recent rebound in overall Defense Department investment in unmanned after a peak in fiscal 2012, according to a recent report by business intelligence provider Govini. Despite war draw-down and sequestration cuts, the UAS market saw a 6 percent compound annual growth rate in the last five years, according to the study.

That rebound in UAS spending is driven primarily by the pivot to the Asia Pacific region, where surveillance missions over vast distances are crucial, and preparation for the so-called "Third Offset" technology push, according to Govini CEO and founder Eric Gillespie.

"In preparation for the Third Offset, preparation for unmanned systems is becoming even more vital to the long-term strategy," said Gillespie in an interview Wednesday. "We're seeing resources allocated and assets allocated to Third Offset preparation."

Another factor is the growing sophistication of these systems and their performance in conflicts in the Middle East over the past decade, Gillespie said. UAS have "proven their value to the DoD" in the last 10 years, he noted.

"I think you're seeing a double effect — UAS technology is getting more sophisticated, and as more of the burden of operations shift from boots on the ground in Iraq and Afghanistan to more maritime surveillance in Asia, we're seeing more acquisition of larger platforms like the Reaper and carrier-launched UAVs by the Navy and Air Force, rather than hand-launched equipment," Gillespie said.

For the Air Force, investment is primarily in large platforms like the Reaper and Global Hawk for surveillance missions. The Air Force spent \$1 billion in FY15 alone on UAS, mainly on acquisition of these systems, according to the report.

Investment in Reaper and related services represents a full 25 percent of all UAS defense awards, an increase from 9 percent in FY12, according to the study. Gillespie chalked this up to increasing demand for larger surveillance platforms, driven by the shift to the Asia Pacific region and the Third Offset.

Notably, General Atomics dominates the UAS market, owning more than a third of the defense market at more than \$4 billion, the report states. Northrop is a distant second, with less than half that capture. Combined, these top two vendors account for more than 50 percent of the UAS market, according to the study.

Coming in at third and fourth, Textron owns 10 percent of the market, while Boeing has 7 percent, said Gillespie.

General Atomics' clear dominance of the UAS market may make the company a target for acquisition by one of the bigger industry players, Gillespie noted.

"The way the market is evolving and given the consolidation of the market today, they own a platform or a set of platforms that should be of great interest to the others players in the market," Gillespie said.

<http://www.defensenews.com/story/defense/air-space/2016/04/06/reaper-demand-drives-uptick-air-force-uas-spending/82698894/>

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## **NATIONAL AIR SPACE:**

### **EPIC Sues Agency for Drone Task Force Meeting Records**

EPIC has filed a FOIA lawsuit against the Department of Transportation for records of the closed-door meetings of the "Drone Registration Task Force". The agency created the Task Force late last year to develop recommendations for registering commercial drones. The Task Force--whose membership included no civil liberties organizations or privacy advocates--met in secret last November before releasing a report. EPIC submitted extensive comments to the Task Force. EPIC's lawsuit was filed just after the FAA's Aviation Rulemaking Committee of industry groups and agency officials recommended easing restrictions that prohibit businesses from flying unmanned aerial vehicles. In EPIC v. FAA, EPIC has also challenged the FAA's failure to establish privacy rules for drones.

<https://epic.org/2016/04/epic-sues-agency-for-drone-tas.html>

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### **1st Success Seen in System Designed to Help Aircraft Automatically Avoid Mid-Air Collisions**

Flight tests demonstrate optical sense-and-avoid capability that detects and tracks nearby aircraft, setting the stage for future manned and unmanned aircraft to autonomously steer clear of them  
[outreach@darpa.mil](mailto:outreach@darpa.mil)

Sense-and-avoid (SAA) system flight test

A research effort associated with DARPA's Aircrew Labor In-Cockpit Automation System (ALIAS) program recently conducted the first successful flight tests of a shoebox-sized, plug-and-play system designed to

enable manned and unmanned aircraft to automatically detect nearby aircraft and avoid potential mid-air collisions. An unmanned air vehicle (UAV) repeatedly used the technology demonstration system to detect and track in real time a Cessna 172G aircraft approaching from various vertical and horizontal distances.

The integrated sense-and-avoid (SAA) system includes a single optical camera that provides imagery for detection and tracking. The system also incorporates passive ranging features that assess the likelihood of an incoming aircraft intersecting the flight path of its host aircraft, and collision-avoidance capabilities to determine the best way to steer the host aircraft out of harm's way. The work is part of a DARPA effort to create a low-cost, easily installed system to detect oncoming or crossing aircraft and determine the best avoidance strategy compliant with standard rules that set minimum vertical and lateral distances between aircraft during flight.

<https://www.youtube.com/watch?v=ZN2ZiyVffPI#action=share>

"This successful flight test is a step toward adding external perception to ALIAS' toolkit for advancing in-flight automation," Dan Patt, "What pilot wouldn't want to set a box on their dashboard that would provide an additional pair of eyes to alert of potential collisions? This SAA system has the potential to enable a wide range of manned and unmanned systems to safely integrate into an increasingly populated and complex airspace."

DARPA has been developing this capability over the past two years and put the technology demonstration system through extensive preliminary testing before the recent flight tests, which evaluated only detection and tracking. Based on the success of those flights, DARPA is planning another phase of the effort, which includes joint funding from the U.S. Air Force Research Laboratory (AFRL).

This follow-on research would shrink the system size; further test the ranging and collision-avoidance features; mature additional capabilities of the system such as detecting aircraft below the horizon and in poor light conditions; and improve calculations for optimal aircraft trajectories to avert impending collision.

The system could ultimately serve as a line of defense in future layered air-traffic management systems that could include Automatic Dependent Surveillance-Broadcast (ADS-B) transponders and ground-based radar systems that are part of the federal NextGen effort. There is particular potential applicability for unmanned air systems or aircraft with reduced crew sizes.

The ALIAS program envisions a tailorable, drop-in, removable kit that would enable high levels of automation in existing aircraft and facilitate reduced need for on-board crew. The program intends to leverage the considerable advances that have been made in aircraft automation systems over the past 50 years, as well as the advances that have been made in remotely piloted aircraft technologies, to help shift and refocus pilot workloads, augment mission performance and improve aircraft safety.

Image Caption: A research effort associated with DARPA's Aircrew Labor In-Cockpit Automation System (ALIAS) program recently conducted the first successful flight tests of a shoebox-sized, plug-and-play



system designed to enable manned and unmanned aircraft to automatically detect and avoid potential mid-air collisions. An unmanned air vehicle (UAV) repeatedly used the technology demonstration system to detect and track in real time a Cessna 172G aircraft approaching from various vertical and horizontal distances. Click below for high-resolution image.

<http://www.darpa.mil/news-events/2016-04-05a>

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### **'Do not view' list for drones**

A Cincinnati company focused on drone privacy – or, more properly, privacy from drones – is compiling a "do not view" list for individuals who don't want their properties photographed by commercial unmanned aerial vehicles (UAV).

Aerdos developed software that would help people keep their faces off the Internet or only allow photos of them to be taken by authorized individuals. It is now developing an extension of that for drones to protect private property from UAVs in commercial uses, like delivering packages.

"There's no good solution right now," Aerdos CEO Geeter Kyrakis told me. "The FAA (Federal Aviation Administration) is worried about things hitting each other and falling out of the sky. It's the elephant in the room for the drone industry."

Aerdos was created by former employees of Harris Corp., who over eight years developed video processing systems for government unmanned aerial vehicles, or drones. Through working in that arena, and with the surge of popularity of drones in commercial and hobbyist spaces, the co-founders of Aerdos saw a need for a way to protect privacy.

The Do Not View List is the first step to providing a measure of privacy to people underneath a drone's flight path. Users sign up on the website, their address coordinates are verified and then they are placed on the list. Participating drone operators then redact – in real time – those properties from a UAV's video feed.

There is no legal expectation of privacy in public spaces, so the features Aerdos offers would be voluntary. Smartphone, drone or camera manufacturers would have to choose to include the technology in their products if they believe it is something consumers want. But it's a conversation that needs to be had, Kyrakis said. He predicts commercial drone use will be fairly widespread in the next five years, and with UAVs hovering 200-400 feet above the ground, people are concerned about what those drones are seeing and who gets that information.

<http://www.bizjournals.com/cincinnati/news/2016/04/01/cincinnati-company-making-do-not-view-list-for.html>

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## **Hawaii set to take off as FAA drone testing site**

A FAA drone testing program that lawmakers say could bring high tech jobs to Hawaii is finally getting the funding it needs. The governor recently approved \$135,000 to hire a chief operating officer for the program.

Advocates like Senator Will Espero say this is a good first step. Hopefully Hawaii can create a little niche market in terms of unmanned aerial systems in both manufacturing and being a part of research and development. Hawaii partnered with Alaska and Oregon to become a drone testing site in 2013, but the state is just now beginning to fund the program.

So how will the program affect residents amid growing privacy concerns. Senator Espero says privacy is very important to the program, "Certainly privacy is paramount and high-priority and want to make certain that even if law enforcement that they have warrants and they're not using individual rights or constitutional rights."

Hawaii was selected for the program partly because it has so much open airspace over water, and because of it's diverse terrain and climate. The FAA is using these test sites to see how to integrate drones into airspace that is already used by planes and helicopters.

Aviation analyst Peter Forman says being part of the program is good for the state and for pilots. "It's something that we all know was coming there's going to be turns carrying packages and things like that in the future so why not have some input."

<http://khon2.com/2016/04/08/hawaii-set-to-take-off-as-faa-drone-testing-site/>

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## **Move to OK commercial drone flights over people**

WASHINGTON (AP) — A government-sponsored committee is recommending standards that could clear the way for commercial drone flights over populated areas and help speed the introduction of package delivery drones and other uses not yet possible, The Associated Press has learned.

The Federal Aviation Administration currently prohibits most commercial drone flights over populated areas, especially crowds. That ban frustrates a host of industries that want to take advantage of the technology.

"Every TV station in the country wants one, but they can't be limited to flying in the middle of nowhere because there's no news in the middle of nowhere," said Jim Williams, a former head of FAA's drone office who now advises the industry for Dentons, an international law firm.

Cellular network providers also want to loosen restrictions so drones, also known as unmanned aerial vehicles, can inspect cell towers, which often are in urban areas. Amazon's vision for package deliveries entails drones winging their way over city and suburban neighborhoods.

The AP obtained a copy of the recommendations, which were sent to the FAA late Friday. The agency is not bound by the recommendations and can make changes when it writes final rules.

The recommendations call for creating four categories of small drones that commercial operators can fly over people, including crowds in some cases.

The first category of drones would weigh no more than about a half-pound. They essentially could fly unrestricted over people, including crowds. Drone makers would have to certify that if the drone hit someone, there would be no more than a 1 percent chance that the maximum force of the impact would cause a serious injury.

For the three other categories, the drones would have to fly at least 20 feet over the heads of people and keep a distance of at least 10 feet laterally from someone.

According to the recommendations:

—Drones in the second category are expected to be mostly small quadcopters — drones with multiple arms and propellers, and weighing 4 pounds to 5 pounds — but there is no weight limit. Flights over people, including crowds, would depend on the design and operating instructions. Manufacturers would have to demonstrate through testing that the chance of a serious injury was 1 percent or less.

—Drones in the third category could not fly over crowds or densely populated areas. These drones would be used for work in closed or restricted sites where the people that the drones fly over have permission from the drone operator to be present. Those people would be incidental to the drone operations and flights over them would be brief, rather than sustained. Manufacturers would have to show there was a 30 percent chance or less that a person would be seriously injured if struck by the drone at the maximum strength impact possible.

—Drones in the fourth category could have sustained flights over crowds. Working with the FAA and engaging the local community, the operator would have to develop a "congested area plan" showing how flight risks would be mitigated. As before, the risk of serious injury would have to be 30 percent or less. Safety tests would be more exacting and the FAA would set a limit on how strong the drone's maximum impact could be.

"The risks are nominal," said Michael Drobac, executive director of the Small UAV Coalition. "The reality is the technology would likely save lives rather than threaten them."

The FAA announced the formation of the committee in February as a way to circumvent traditional federal rule-making procedures, which can take years. The committee was made up of 27 companies or trade associations, including drone manufacturers and companies that want to fly drones, as well as airline and private pilots, airports, crop dusting companies and helicopter operators.

A last-minute disagreement nearly kept the committee from meeting the Friday deadline for the recommendations.

The Air Line Pilots Association and trade associations for the helicopter and crop dusting industries wanted to require that all commercial drone operators pass an aviation knowledge test administered in person by the FAA and receive a background check from the Transportation Security Administration, according to an industry official familiar with the discussions.

Most committee members opposed requiring anything more than an online knowledge test. The matter was resolved by the inclusion of a dissent by those in favor of the FAA test and TSA clearance. The official spoke on condition of anonymity because he was not authorized to speak publicly about internal discussions.

The FAA initially described the panel as a "micro" drone committee. The agency defines such drones as those weighing less than 4.4 pounds. But the committee decided not to set a weight limit for most of the categories. That means it's possible that any "small" drone, which the FAA defines as weighing less than 55 pounds, could win approval to fly over people if the drone met the safety criteria laid out in the recommendations. For example, a smaller drone that flies at higher speeds with fast-moving propellers may prove more of a risk than a heavier drone that flies more slowly and whose propellers don't rotate as quickly.

<http://www.bigstory.ap.org/article/2b37d266de4b485a8bb086981d0c2ecb/apnewsbreak-move-ok-commercial-drone-flights-over-people>

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## **PUBLIC SAFETY:**

### **Nevada Company Teams With the NY UAS Test Site**

Praxis Aerospace Concepts International, Inc. Announces a Partnership With Griffiss International Airport to Expand Its Capabilities for Future NASA Task Orders and UAS Integration Efforts

HENDERSON, NV -- April 04, 2016-

Praxis Aerospace Concepts International, Inc. today announced it has entered into a partnership with the New York UAS Test Site, Griffiss International Airport, to provide the Test Site additional expertise as they accomplish requirements toward their support of NASA. The goal of which is to help integrate unmanned air vehicles into the world around us.

NASA has invited test sites to participate in NASA activities, as well as to encourage teaming across test sites to gain cost efficiencies and maximize research data that will be delivered to NASA. The Unmanned Aircraft Systems Integration in the National Airspace System project, or UAS in the NAS, will contribute capabilities designed to reduce technical barriers related to safety and operational challenges associated with enabling routine UAS access to the NAS. Subsequently, Oneida County has been awarded a 5 year

Indefinite Delivery Indefinite Quantity contract for future NASA task orders. These Task Orders may require Praxis participation and expertise toward their accomplishment.

Praxis Aerospace Concepts International, Inc. is best known in the unmanned systems industry for its White Label services, supporting FAA UAS Test Sites, Universities and corporate partners with Robotics Management, Technical Services and Autonomous Technology Testing. PACI is a partner of ASSURE, the FAA's UAS Center of Excellence. "We are very excited to work with Oneida County and Griffiss International Airport," said Jonathan Daniels, CEO, Praxis Aerospace Concepts International, Inc. "Teaming up with the New York UAS Test Site to engage in NASA's UAS in the NAS research is an exciting development for our company."

"Praxis Aerospace Concepts International, Inc. is a great partner and this partnership reflects our desire to collaborate with companies such as Praxis that have the excellent reputation and expertise within the UAS community and share our commitment to the growth of the UAS industry locally, at the Nevada Drone Port and nationally," said Anthony J. Picente, Jr., Oneida County Executive and Operator of the New York UAS Test Site, Griffiss International Airport. The New York UAS Test Site at Griffiss International Airport is known for successfully testing UAS from small category to a full scale fixed wing aircraft and it's state of the art range instrumentation system that combines the SRC LSTAR 3-d Radar and the Saab Sensis WAM sensors as well as the soon to be added X-Band Surface Movement Radar.

<http://m.marketwired.com/press-release/nevada-company-teams-with-ny-uas-test-site-conduct-potential-nasa-research-worlds-first-2111597.htm>

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### **Drone-makers launch new advocacy group**

Drone manufacturers are launching a new advocacy group as federal regulators work toward plans to integrate unmanned craft into the national airspace.

The Drone Manufacturers Alliance will push for policies that emphasize innovation and safety for people who operate small commercial and recreational drones.

The coalition will primarily focus on issues affecting smaller aircraft.

"There are significant economic and social benefits to drone operations in the U.S., and industry must work with policymakers to ensure a safe environment for flying," said Kara Calvert, director of the alliance, in a statement on Monday. "The Drone Manufacturers Alliance believes a carefully balanced regulatory framework requires input from all stakeholders and must recognize the value and necessity of continued technological innovation."

The Federal Aviation Administration (FAA) is developing a broad plan for the safe integration of private drones into the national airspace.

The agency proposed a rule last year to allow the routine use of certain small commercial drones in the aviation system. The rule is expected to be finalized this spring. The FAA has also required all small-drone users to register on its website.

The new alliance of drone manufacturers includes 3D Robotics, DJI and GoPro – all three of which previously belonged to the Small UAV Coalition – as well as Parrot SA. Calvert said the new coalition will have a narrower focus on issues that specifically pertain to manufacturers.

The group will closely monitor the FAA rulemaking as well as a bill to reauthorize the agency that is moving through Congress, though the alliance is still working to develop official policy positions.

“By highlighting innovation and emphasizing education, we intend to work with policymakers to ensure drones continue to be safely integrated into the national airspace,” Calvert said.

<http://thehill.com/policy/transportation/275113-drone-makers-launch-advocacy-group>

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### **Using UASs for Transmission R&D**

The Electric Power Research Institute (EPRI) initiated a concerted effort into the application of unmanned aerial systems (UASs) for transmission research in 2012. The effort has accelerated and grown as UASs have increased in their capability and the Federal Aviation Administration (FAA) regulations have relaxed.

The first challenge was defining the role EPRI should play to meet the mission of supporting utilities to provide safe, reliable, cost-effective and environmentally responsible electricity for the public benefit. The team developed a comprehensive research plan to provide EPRI members with the technical basis and business case to effectively and safely take advantage of this ever-changing technology.

Presently, 23 utilities are fully engaged in the EPRI transmission research project. The most active members in the research project are leaders in the field, implementing regular UAS missions and pushing the envelope by doing trials of new technologies such as beyond-line-of-sight inspections.

#### **Use Cases**

EPRI is developing use cases that define potential applications for UASs to aid in all aspects of the transmission asset life cycle, with transmission line inspection being a first priority. Other applications such as complementing transformer inspections, aiding in conductor stringing and performing micro-ohm meter measurements on conductor splices will aid utilities with applying UASs in the field, and aid technology developers and service providers to adjust their offerings to meet the industry's needs.

#### **Evaluation and Demonstration**

To date, EPRI has executed two fly-offs to evaluate the capability of different technologies and service providers in a well-defined scientific manner. In 2014, an evaluation of six different technologies was

implemented in Canada on de-energized structures at HydroOne. In 2015, six different service providers were evaluated in New York in an EPRI-funded, -designed and -led test at the New York Power Authority on 345-kV structures. This evaluation was attended by all of the funding utilities with more than 40 EPRI advisors present.

In both tests, vendors and providers were given well-defined requirements and had to submit results in a consistent format. The flights and inspection procedures were observed, and the submitted inspection results were measured to evaluate effectiveness. The evaluations provided immediate results that can aid industry in the selection of technology as well as practices of excellence in inspection and reporting.

The results of these evaluations have been provided to members in both video and report formats. A publicly available summary has been posted by EPRI on YouTube as “UAS Field Test Summary.”

### Operations in an Electrical Environment

It is important to confirm that UASs perform in an effective and safe manner without impacting the reliability of transmission system. Testing is required to confirm UASs can exist in complex electrical environments; including those in which magnetic fields, corona and arcing activity exist. EPRI is developing and executing a test protocol that can be used to confirm that any technology to be used on transmission assets can withstand this electrical environment. A possible use of this test protocol would be to ensure technology and service providers are able to safely and effectively operate in a complex electrical environment.

Testing also is being performed to determine the impact of UASs on the flashover strength of the air gaps and insulator strings to ensure reliable and safe operation of the transmission system.

Finally, the team is documenting safe work practices for operators and the public.

### Functional Specifications

One of the major deliverables that will be provided as a result of this work is a functional specification utilities can use to acquire UASs or engage service providers. Functional specifications will address topics ranging from how to operate in windy conditions, how to operate in high electric and magnetic fields, and how results should be collected and presented.

### Business Case and Awareness

In September 2015, EPRI published the “Update on FAA Regulations on Unmanned Aircraft Systems: An EPRI White Paper” to document the state of FAA regulations in the United States. This document aids EPRI members in navigating the current state of UAS regulations. EPRI is also developing a framework to help utilities build business cases to confirm the need for the use of UASs.

As UASs are increasingly embraced by transmission utilities, the research needs will change. Together with its membership, EPRI will adjust and adapt the research portfolio to meet these new challenges and close the gap between utility and regulatory requirements and evolving technologies.

<http://m.tdworld.com/overhead-transmission/using-uass-transmission-rd>

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## **DRBA Conducts Inspection Trials of Delaware Memorial Bridge Using Drone Technology**

New Castle, DE —The Delaware River and Bay Authority (DRBA) conducted an inspection today of the Delaware Memorial Bridge Twin Span using an Unmanned Aerial System (UAS) or drone. Keystone Aerial Surveys, Inc., based at Northeast Philadelphia Airport, in cooperation with WSP/Parsons Brinckerhoff, utilized an Inspire Pro 1 and Maverik X8 to perform the inspection services for DRBA as a test of the technology. The test inspection flights occurred on the New Jersey side of the Bridge complex on

Tuesday, April 5.

“The Delaware Memorial Bridge Twin Span is subjected to a rigorous inspection program every year,” said Shekhar Scindia, DRBA project engineer. “Drones have the potential for making bridge inspection operations significantly safer and more cost efficient.” He added that the annual inspection costs of the Authority bridges at times exceeds \$500,000.

“We are pleased to be able to work with the DRBA on this project,” said David Day, Executive Vice President of Keystone Aerial Surveys. “We feel confident that our technology can be used to improve and enhance their regular bridge inspection processes.”

This inspection tested the viability of using drones to inspect areas of the Bridge that are hard to access. The drone obtained video and still imagery within a concrete anchorage, externally of a concrete pier, and of the bridge’s steel cable and superstructure. The DRBA will assess the relative quality of the data recorded and the operational conditions, compared to traditional methods.

The use of drone technology may enable inspections to occur in less time, for less money, at better quality and with significantly reduced lane closure requirements.

Cape May County, NJ airport – KWWD, operated by the DRBA, has also hosted drone research campaigns.

“Working with our partners in Cape May County, the DRBA has established Cape May County airport as a venue for collaboration and innovation in the UAS field,” said Scott A. Green, DRBA Executive Director. “Today’s test of the use of drones for bridge inspections at the Delaware Memorial Bridge is a case of putting our money where our mouth is.”

The DRBA has been actively engaged in safe drone research and development as a member of The Cape May County NJ UAS Innovation Forum and The Delaware UAS Task Force.

The combination of these sensors and platforms allows Keystone to offer services for a wide range of applications, including survey, mapping, inspection, real estate, precision agriculture and construction



monitoring and as-built documentation. Learn more about Keystone's UAS Division at [www.kasurveys.com/](http://www.kasurveys.com/uas) uas.

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### **Cyberhawk conducts boiler inspection**

Cyberhawk Innovations has completed the inspection of a Bulgarian company's commercial internal steam boiler using a remotely operated UAS, it announced on 5 April.

The inspection was carried out at an operational thermal power plant and the project included a visual inspection of all equipment for integrity and damage assessment.

UAS technology was selected as the preferred method of inspection for this project to reduce the safety risk posed to personnel working at height as well as to overcome restrictions associated with working in confined spaces. Usually this type of inspection is conducted by technicians who are suspended on ropes to inspect the boiler's internal structure. Zero GPS signal inside the tank and dark conditions added to the difficulty of the task for the UAS pilots.

According to the company, the inspection of the critical components was completed within a day, in comparison with rope access which would usually take between three to four days for the same work-scope.

Philip Buchan, commercial director, Cyberhawk, said: 'Our pilots undertake four levels of rigorous internal training and will typically require a number of years' experience before being mobilized to our most challenging projects, such as offshore or internal inspection projects. The successful completion demonstrated the level of skill our pilots possess and the high quality reporting produced by our engineering team.'

He added: 'The boiler environment is very different from what we are used to; it's a dark and dusty environment, presenting a whole host of additional operational challenges. The lack of GPS signal meant our pilot had to work with extra precision to produce the desired close visual inspection results.'

<https://www.shephardmedia.com/news/uv-online/cyberhawk-uses-uav-boiler-inspection/>

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### **Qualcomm Technologies receives FAA authorization necessary to accelerate drone technology development**

Last week, the U.S. Federal Aviation Administration (FAA) granted Qualcomm Technologies a certificate of authorization (COA) to perform outdoor testing of drones (known as Unmanned Aircraft Systems or UAS) on our San Diego campus, where we have extensive R&D facilities. With this grant, the Qualcomm Research team can now take even greater advantage of our on-campus resources to further accelerate the research and development of our UAS technology using Qualcomm Snapdragon processors.

Our goal is to test and refine UAS technologies, such as autonomous operation and reliable 4G/5G communications, which help enhance safety in drone deployments—protecting people and property on the ground, as well as other aircrafts in the airspace. This grant of the COA is unique since the Qualcomm campus is located within highly restricted Class B airspace within a few miles of an airport with an operational air traffic control tower. The authorization allows the research team to evaluate new technologies in a real-world urban environment—under tight controls at all times.

The authorization grants permission for operation of UAS in Class B airspace at and below 200 feet above ground level for the purpose of research and development.

Qualcomm is committed to the development of UAS technology necessary for safe operations of both consumer and commercial UAS in the national airspace. Our commitment is evidenced in part by the extensive controls that we have successfully implemented in order to qualify for this COA, which will ensure safe flight operations while operating in the highly restricted airspace around our campus.

Our UAS testing will focus on two main areas of research to enable the development and proliferation of safe, advanced, and efficient UAS operations into the national airspace. The first relates to development of remote operation and autonomous flight control algorithms that run on the Qualcomm Snapdragon Flight drone development platform. These algorithms, which utilize exclusive, highly advanced control and computer vision engines, enable a wide variety of critical operations for safety, including autonomous navigation, obstacle avoidance, way-point to way-point navigation, landing zone determination, stabilized hovering, and sensor-aided dead reckoning, among others.

A second area of research involves another crucial aspect of commercial UAS use: the communications link from the UAS to the ground, and vice versa. A reliable, robust, secure and efficient communications link is an essential component of safe UAS operations. See, for example, Qualcomm’s response to the FAA notice of proposed rule making on operation and certification of small Unmanned Aircraft Systems (UAS). “Lost link” scenarios, which cellular connectivity can help protect against, can present serious safety concerns, especially when drones are operating beyond visual line of sight (BVLOS).

Qualcomm Technologies will use this new COA to focus on UAS research and testing using cellular technologies, including the developing 5G technologies, with the aim of enabling UAS operations BVLOS and at night. The combination of highly reliable communications capabilities with other key features we are developing and refining, such as computer vision, sensor processing and continuously updated geofencing, are all necessary to enable safe BVLOS operations.

To learn more about this COA and why it’s important for Qualcomm, please read our initial petition to the FAA for a Section 333 exemption, which provides more details on our request and our work on UAS. To learn more about Qualcomm Research’s overall robotics and drone initiatives please visit our robotics research page.

<https://www.qualcomm.com/news/onq/2016/04/07/qualcomm-technologies-receives-faa-authorization-necessary-accelerate-drone>

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## **Google Patent for UAV Delivery of Medical**

A new patent awarded to Google outlines a device that can call for a drone to fly in with specific medical equipment. Last year, Google patented the idea of flying drones to medical emergencies with life-saving technology onboard, and now it seems the tech giant has a plan for how we would contact these drones.

The device in today's patent looks like a cross between an old HAM radio and one of the callboxes found on the sides of highways. Users would press a button for their specific medical emergency, and it would deploy a drone to the scene.

According to the Google patent, this could save precious minutes in emergencies, such as an anaphylactic shock caused by an allergic reaction, or a heart attack. The autonomous drone could head right out to the emergency with a defibrillator or a shot of adrenaline on board. As the patent puts it:

For example, if it takes 8-9 minutes for an EMS unit such as an ambulance or fire truck to arrive at the site of the emergency under normal circumstances, the first 60-120 seconds of that time may involve the dispatch (e.g., calling 9-1-1, speaking to an operator, etc.). A UAV, on the other hand can be dispatched with an example system without the human interaction required for typical 9-1-1 emergency response, and may be able to travel faster than a ground vehicle because it does not face traffic conditions and will have less distance to cover since it can travel "as the crow flies" versus following roads.

The patent also suggests that the device could deploy autonomous vehicles—perhaps like a self-driving car—suggesting that Google might also be thinking about uses for its self-driving car program beyond ferrying people on their commutes.

The patent also outlines how the device would connect to Google's drone fleet—it could be either through a wifi, hardwired, or a cell connection—but doesn't seem to suggest that the company has thought about implementing this in, say, an app. Presumably, the system would be most useful for people needing medical assistance wherever they are, not just near one of Google's boxes—though the drones would likely need an open space to land. It's possible Google wouldn't want people calling drones from densely-packed areas

[http://www.uasvision.com/2016/04/12/google-patent-for-uav-delivery-of-medical-equipment/?utm\\_source=Newsletter&utm\\_campaign=43b48370e0-RSS\\_EMAIL\\_CAMPAIGN&utm\\_medium=email&utm\\_term=0\\_799756aeb7-43b48370e0-297560805#sthash.6CXHFV5b.dpuf](http://www.uasvision.com/2016/04/12/google-patent-for-uav-delivery-of-medical-equipment/?utm_source=Newsletter&utm_campaign=43b48370e0-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-43b48370e0-297560805#sthash.6CXHFV5b.dpuf)

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## **SENSORS/APPLICATIONS:**

## **'Insect Eyes' System Could Improve Drone Flight Navigation**

One of the vexing issues with drones is that the potential safety risk they pose to airlines. There have been numerous instances where these machines have been sighted in restricted areas around airports or hovering close to a plane in mid-flight raising the possibility of a collision.

However, new research explains that a biologically-inspired mechanism could improve the navigation prowess of these airborne robots.

Vision researchers Emily Baird and Marie Dacke from Sweden's Lund University found that an insect like the Panamanian green orchid bee has a unique ability to avoid obstacles in its natural habitat by assessing the intensity of light filtering through holes in leaves or similar obstacles.

Baird used synchrotron radiation to develop three-dimensional images of insect's vision indicating this skill helps the creatures determine if an opening is large enough for them to fly through.

One of the key advantages the bee's brain views patterns instead of details allowing it to figure out the best speed and flight route.

"The system is so simple - it's highly likely that other animals also use light in this way. The system is ideal for adapting to small, lightweight robots, such as drones. My guess is that this will become a reality within five to 10 years," Baird said in a statement.

Ultimately, this system could help drones fly independently without human assistance. But Baird and Macke still need to convert these biological results, mathematical models and digital systems to ensure it could work for these bots.

<http://www.rdmag.com/articles/2016/04/insect-eyes-system-could-improve-drone-flight-navigation>

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## **Social Networking App for Drone Enthusiasts**

Thanks to the internet, you can access Redd-it pages and various forums for drones and where you can find fellow drone enthusiasts. However drone maker DJI has decided to try and make it easier by creating a social network designed for drone enthusiasts where your fellow drone hobbyists will be able to look for other like-minded individuals nearby and connect with them.

Dubbed "DJI+ Discover", this is an app designed for both iOS and Android. According to DJI's description, "The mobile app connects people socially and professionally by enabling drone-pilots and drone enthusiasts to start conversations and meet up while also functioning as a professional marketplace for aerial service providers and potential clients."

The app will be broken down in four different sections: Nearby Search which shows social and professional users nearby; Experience which helps to guide users to nearby stores or official events;

Store which will take users to DJI's online store; and Forum where DJI's official forums are basically integrated into the app itself.

According to Paul Guo, Director of E-Commerce at DJI, "Drone pilots like to get together to fly, learn from each other and share experiences with like-minded people. In the same way, people want an easy way to find trustworthy professional aerial service providers nearby. DJI+ Discover lets people in the same area connect socially and professionally in a way that will bind the drone community even tighter together."

Users interested in checking out the app can hit up DJI's website for the download.

<http://www.ubergizmo.com/2016/04/dji-social-network-drone-lovers/>

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### **Researchers unite to address the problems that drones and other unmanned vehicles encounter in a harsh Arctic climate**

Drones and other remote-controlled and autonomous vehicles face a series of challenges when deployed in harsh and cold environment. Cool humid air ices down wings, propellers and crucial sensors on aircraft, and low temperatures drain batteries. Satellite and mobile phone coverage is often inadequate in high and scarcely populated latitudes, making communication and data transfer difficult and/or highly expensive, and the magnetic pole is constantly moving, making several instruments less reliable in the polar region. Further, sea ice makes communication with underwater gliders and other underwater vehicles even more difficult and poses a hazard to surface vehicles.

During a Svalbard Strategic Grant-funded workshop in Tromsø on 5-6 April, users and developers of different unmanned robots, such as remotely operated underwater vehicles (ROVs), autonomous underwater vehicles (AUVs), unmanned aerial vehicles (UAVs), and unmanned surface vehicles (USVs), met to exchange their experiences, frustrations and possible fixes with each other. Researchers found that they were facing many of the same climate-induced challenges and were working on parallel solutions.

"It seems like everyone is trying to invent the same wheel," Professor Cathy Cahill at the University of Alaska Fairbanks noted.

The two-day workshop, labelled The Remote Controlled and Autonomous Measurement Platforms Flagship (ReCAMP) by the organizing consortium led by Norut Northern Research Institute, united researchers from several countries and from different research communities in Svalbard.

Project manager Dr. Rune Storvold at Norut acknowledged a need for further collaboration, coordination and data sharing among the partners, and informed that a second ReCAMP workshop would be held in 2017, possibly in Trondheim. The research network is open to new partners, Dr.

Storvold stressed. He added that funds are now available to facilitate the exchange of Arctic-related experiences and technologies, through so-called Short Term Scientific Missions.

<http://phys.org/news/2016-04-problems-drones-unmanned-vehicles-encounter.html>

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### **Picobug – Mesoscale Robot that can Run, Fly, and Grasp**

The Vijay Kumar Lab at Penn Engineering just published this video of one of its current research projects.

In this paper they present the flying monkey, a novel robot platform having three main capabilities: walking, grasping, and flight. This new robotic platform merges one of the world's smallest quadrotor aircraft with a lightweight, single-degree-of-freedom walking mechanism and an SMA-actuated gripper to enable all three functions in a 30g package.

The main goal and key contribution of this paper is to design and prototype the flying monkey that has increased mission life and capabilities through the combination of the functionalities of legged and aerial robots.

Source: YouTube

[http://www.uasvision.com/2016/04/11/picobug-mesoscale-robot-that-can-run-fly-and-grasp/?utm\\_source=Newsletter&utm\\_campaign=c620eec8ef-RSS\\_EMAIL\\_CAMPAIGN&utm\\_medium=email&utm\\_term=0\\_799756aeb7-c620eec8ef-297560805#comments](http://www.uasvision.com/2016/04/11/picobug-mesoscale-robot-that-can-run-fly-and-grasp/?utm_source=Newsletter&utm_campaign=c620eec8ef-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-c620eec8ef-297560805#comments)

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## **COUNTER UAS:**

### **US Army's Multi-Mission Launcher Defeats UAS Threat**

WASHINGTON — The US Army's self-built Multi-Mission Launcher successfully defeated a cruise missile target and an unmanned aircraft system using an AIM-9X missile at White Sands Missile Range, New Mexico, the service announced Thursday.

The test against the cruise missile was conducted on April 1 and the test against the UAS occurred on March 29 as part of an engineering demonstration of the Indirect Fire Protection Capability Increment 2-Intercept (IFPC Inc 2-I).

The IFPC Inc. 2-I is intended to defeat UAS, cruise missiles, rockets, artillery and mortars.

The Army also fired a Miniature Hit-to-Kill (MHTK) missile from the MML on April 4. The MHTK has no warhead but defeats rockets, artillery and mortars with kinetic energy in a direct hit, the service said in a statement.

The MML is being developed internal to the Army and represents the first development of a major program by the government industrial base in more than 30 years, the service has said.

The launcher is also able to fire Raytheon's Stinger missiles and Lockheed Martin's Longbow Hellfire missiles, but other missiles will be tested to prove its flexibility.

The Army spent \$119 million to build the prototypes, which includes owning the technical data rights. The cost of developing the system outside of the Army would have been about three times as much, according to information obtained during a tour with the acting Army secretary last month of the Aviation & Missile Research and Engineering Development Command (AMRDEC) at Redstone Arsenal, Alabama, where one of the MMLs was on display.

The IFPC Inc 2-I is a joint effort between AMRDEC and the Army's Program Executive Office for Missiles and Space's Cruise Missile Defense Systems (CMDS) project office.

The Army plans to build six more MMLs in the engineering and manufacturing development phase at Letterkenny Army Depot.

<http://www.defensenews.com/story/defense/land/army/2016/04/07/us-armys-multi-mission-launcher-defeats-cruise-missile-uas-threat/82765932/>

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## **INTERNATIONAL:**

## **COMMENTARY:**

### **How drones can improve scientific research in the field**

Drones – and promises about drones – seem ubiquitous these days. And some of what we associate with drones comes with varying degrees of scariness.

We think of automated planes shooting missiles, drones flying near sensitive nuclear power plants or quad-copters crashing into crowds while filming. If we think about everyday possibilities, we envision toys for children or companies promising deliveries, which sounds like a futuristic version of Hitchcock's horror film "The Birds."

However, drones – or, to use the technical term, unmanned aerial vehicles (UAVs) – show promise to help with a large number of societal and environmental problems.

As a researcher in aerial robotics, I'm trying to bring some cutting-edge ideas for using drones closer to reality. Some of these projects aim to keep sensors alive, measure hazardous or remote environments, and deal with scenarios that would be dangerous to humans.

Links to power and data

As our world becomes more filled with sensors – such as on roads and bridges, as well as machines – it will be important to ensure the increasingly distributed monitoring devices have power. Here, drones can help. UAVs can provide wireless recharging to hard-to-access locations such as sensors monitoring bridges or floating sensors on lakes.

Idealized figure representing a number of sensors (in red) monitoring a bridge and the UAV flying to wirelessly recharge the sensors' batteries. Carrick Detweiler, University of Nebraska-Lincoln, CC BY-ND

Dr. Carrick Detweiler at the University of Nebraska-Lincoln and I have developed a system that allows a UAV to fly to a bridge, identify which battery to charge, and wirelessly recharge it, in a manner similar to those pads on which you can just drop your cellphone.

Over time, the UAV can visit repeatedly, recharging all of the batteries and keeping all the sensors live. That will provide more data to determine when the bridge needs repair. Lack of even one or two key pieces of data can make the rest of the monitoring less helpful, so having functioning, charged sensors is critical to keeping the information flowing.

An Ascending Technologies Hummingbird quadcopter, which serves as the base UAV for wireless recharging of sensors, monitoring of crops and measuring of water. Randall Gee, University of the Pacific, CC BY-ND

Our ongoing research also explores how to retrieve measurements from floating sensors, which will allow us to monitor water quality. Similar to working with bridge monitors, the UAV flies over the sensors, collecting data from each one and returning to a base station.

This speeds up data processing, and improves data collection: without the UAV, researchers would have to get in a boat to collect all of the sensors. This is tedious and can be expensive, as the scientists need to drive a boat to a boat ramp, spend all day collecting the data from the sensors, reset the sensors and then analyze the data.

If a sensor has failed in the time since the last visit, the scientist will discover this only when collecting data and will have lost all potential data, creating a hole in the data set and making it more difficult for the scientist to understand that environment. With a UAV, the scientist can relax in her office, send the UAV out for data on a daily basis, quickly identify failed sensors and have the UAV replace those sensors. The likelihood of gathering a good set of data that the scientist can use to learn more about our environment then increases.

In addition to supporting monitoring devices, UAVs can take measurements themselves. Research at UNL is using UAVs to measure agricultural crop heights; Arizona State University scholars are gathering remote imagery to study the role of water in the environment; and Swiss researchers are mapping forest trails.

Without UAVs, these tasks are harder. Crop heights would require farmers to visit all of their fields; ecohydrology would need expensive satellite or plane data collection; and forest trail mapping would



require regular confirmation from hikers. These are only a few of the many ways that UAVs can help gather hard-to-measure things in hard-to-reach locations.

#### Disaster response

UAVs can also help respond to disasters. We are exploring how UAVs can monitor rivers to predict floods, an extension of our prior work that only used sensors.

Timely prediction of flooding requires extensive data, something easily obtainable in urban, developed areas. For rural and less developed areas, though, the infrastructure to measure rivers and weather for prediction is often too expensive. UAVs can supplement measurements to easily provide the appropriate information to improve predictions and save lives.

Dr. Detweiler is also looking at how to start controlled burns with UAVs, to help fight wildfires and help with land management. Fire breaks help restrict wildfire movement, but creating them is dangerous to firefighters who are directly in the line of the fire.

A UAV can fly close to the fire and drop small capsules in precise locations. Those capsules self-ignite and start a small controlled burn. Firefighters do not have to get close at all; they just have to identify the location for the UAV.

They can also help with more man-made disasters. A group at DePaul University uses UAVs to monitor the Dead Sea and reveal archaeological sites that are being looted. Typically solving this problem would use satellites, where measurements are expensive and rare. UAVs provide more frequent and cheap options that could allow archaeologists to save these sites.

As promising as UAVs are, though, much of the potential of these systems remains distant. Until the FAA decides how best to manage these systems (especially in the commercial context), UAVs will not fly around freely, especially out of the eyesight of a pilot. In addition, technical challenges remain, including reliable methods for avoiding obstacles and handling changing weather conditions (such as sudden high winds).

Overall, UAVs have great potential for the good and useful. Hopefully, we remember that when the news focuses on the dangerous and frivolous.

<https://theconversation.com/how-drones-can-improve-scientific-research-in-the-field-54696>

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#### **Unmanned systems market shifts to new customers**

The unmanned aerial system market was once dominated by the Army, which was the first of the services to jump on the potential of UAVs to support the warfighter.

The Air Force, with its fighter pilot culture, was slow to adopt the technology, but a new study by the market research firm Govini shows that in recent years, the Air Force has caught up and is now the Defense Department's largest buyer of unmanned aerial systems.

At its peak in 2012, the Army represented 42 percent of the market, but in fiscal 2015, the Air Force was the biggest buyer with 37 percent of the market. Last year alone, the Air Force made \$1 billion in awards, according to Govini.

The Navy also has become an important buyer and actually is growing the fastest with a 17 percent compound annual growth rate since 2012, when it awarded a large ISR-as-a-service contract to Boeing. Overall, it accounts for 14 percent of the market.

While the customer set may be shifting, the vendor side hasn't. General Atomics remains the largest player with about a third of the overall market. General Atomics makes the Reaper family of drones.

Northrop Grumman is second with about 16 percent, according to Govini.

Together General Atomics and Northrop Grumman control more than 50 percent of the market.

Textron has 10 percent, and Boeing controls 7 percent. The rest of the market share is held by multiple companies.

Besides the drones themselves, there are the systems to maintain and operate them, including networking, intelligence and data analytics. Govini is predicting opportunities around the UAS lifecycle including procurement and modernization.

Govini found that the overall market peaked in 2012, but that there is a resurgence taking place.

In an earlier report, Govini tapped the UAS market as a ripe area for consolidation and that companies such as General Atomics are likely acquisition targets for larger defense companies looking to solidify their UAS platform position.

The UAS Govini report draws three conclusions:

The market is re-surging

The market has shifted away from the Army as other DOD agencies get more involved

Opportunities will focus on the entire lifecycle, including procurement, modernization and operations and maintenance.

All three represent business opportunities. The resurgence in particular might be broadest and includes the continuing evolution of UAS technology and DOD's third offset concept.

The third offset is the latest version of the U.S. strategy to use technology as a way of making up for weaknesses in other areas.

<https://washingtontechnology.com/blogs/editors-notebook/2016/04/govini--uas-market-report.aspx?m=1>

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## **Drone Warfare Beware of Unintended Consequences**

Unmanned aerial vehicles (UAVs), or “drones,” are among the most significant technological advances of this century. Within just eight years from 2002 to 2010, the Department of Defense’s inventory of UAVs increased 40-fold. Since then, drones have become the weapon of choice in hostile, remote areas throughout the world. Now, as the White House prepares to release its drone “playbook,” the entire nation must evaluate the efficacy of our policies, and the unintended consequences of drone warfare.

### **The ease of going to war**

On the surface, drones are an obvious force multiplier. However, there are ramifications to being able to wage war so easily anywhere in the world that cannot be underestimated. In his book, *Wired for War*, P.W. Singer, said, “Unmanned systems represent the ultimate break between the public and its military. With no draft, no need for congressional approval, no tax or war bonds, and now the knowledge that the Americans at risk are mainly just American machines, the already lowering bars to war may well hit the ground. A leader needn’t carry out the kind of consensus building that is normally needed before a war, and doesn’t even need to unite the country behind the effort.” With the prevalence of this relatively new technology, national security decision-makers must resist the temptation to always settle for launching new drone strikes that may potentially draw the United States into conflict. There are some situations where drones are the best option, but they are not a global panacea to all of our political-military challenges.

Unmanned systems have not only changed the ease of conducting military operations but have also changed the “experience” of warfare entirely. As opposed to being deployed for months on end, in this new era of drone warfare, the operator may be piloting a drone over Afghanistan while sitting at a control console in Nevada, and then go home to his/her family each night. This phenomenon has been described as, “the first generation to go to war without actually going to war.” That is a transformational shift in how the United States conducts wartime operations and ultimately also exacerbates the ease in which the United States could enter a conflict.

### **Loss of intelligence**

The importance of timely, actionable intelligence is crucial to national security. The White House Policy on the Use of Force in Counter-terrorism Operations Outside the United States outlines that, “the policy of the United States is not to use lethal force when it is feasible to capture a terrorist suspect, because capturing a terrorist offers the best opportunity to gather meaningful intelligence and to mitigate and disrupt terrorist plots.”

A perfect illustration of this policy occurred in March 2016, when the United States declared that the U.S. military conducted airstrikes against sites believed to be integral to ISIL's chemical weapon program. The intelligence that led to these strikes was provided by a senior ISIL operative that was captured three weeks earlier by the U.S. Expeditionary Targeting Force (ETF). The United States would not have had this intelligence if they had instead elected to use a missile from a drone to kill the operative rather than capturing him alive. A partiality towards drone strikes depletes the intelligence community of actionable information that could save American lives in the future.

### Terrorist recruitment

The impact of U.S. drone strikes on terrorist recruitment is concerning and not yet fully understood. Former Vice Chairman of the Joint Chiefs of Staff, General James Cartwright (Ret.), stated that the United States is witnessing "blowback" from drone strikes. This "blowback" General Cartwright described could potentially be anything on the spectrum from resentment of Americans to full-fledged radicalization, and this cannot be taken lightly.

It is well documented that terrorist propagandists have been using U.S. drone strikes as a recruitment tool. Inspire is a radical online magazine that seeks to motivate people to commit terrorist acts and is generally associated with Al Qaeda in the Arabian Peninsula (AQAP). A 2013 Inspire issue declared that, "These missiles are usually carried by the unmanned drones to kill this or that target cold-bloodily... These missiles have no eyes and their launchers are more blind. They kill civilians more than mujaheddin." While the hyperbole in this excerpt and many others like it is clearly evident to most, it is still appealing to some.

There have been examples in the United States already that demonstrate the connection between drone strikes and terrorist recruitment. In one case, Pakistani-American Faisal Shahzad, the failed Times Square car bomber, was asked by the judge at his trial how he could rationalize planting a bomb near innocent civilians including children. Shahzad coldly responded saying that U.S. drone strikes "don't see children, they don't see anybody. They kill women, children, they kill everybody." This is why preventing civilian casualties from drone strikes is so important. No one questions that drones can be an effective military weapon if employed responsibly. However, the United States must be careful to not choose the short-term tactically smart option only to be trapped by a long-term strategically dumb decision.

### The Way Ahead

Unmanned Aerial Vehicles are typically the least costly method of targeting terrorists and extremists abroad, both in terms of actual cost and danger to Americans. However, the second and third order effects must not be overlooked. The United States must be cognizant of the inherent loss of intelligence from drone strikes, continue to make progress on reducing civilian casualties, and be aware that there may be unintended consequences not yet known. Drones are a phenomenal tool, but not a strategy. Ultimately, the United States must not over-rely on drones or we will fail to see the consequences until it is too late.

Andrew Poulin is a naval officer. The views expressed here are his own and do not necessarily reflect those of the Department of Defense or the Department of the Navy.

[http://www.realcleardefense.com/articles/2016/04/08/drone\\_warfare\\_109237.html](http://www.realcleardefense.com/articles/2016/04/08/drone_warfare_109237.html)

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### **Supervising and controlling unmanned systems**

Proliferation in the use of Unmanned Aerial Systems (UASs) in civil and military operations has presented a multitude of human factors challenges; from how to bridge the gap between demand and availability of trained operators, to how to organize and present data in meaningful ways. Utilizing the Design Research Methodology (DRM), a series of closely related studies with subject matter experts (SMEs) demonstrate how the focus of research gradually shifted from “how many systems can a single operator control” to “how to distribute missions among operators and systems in an efficient way”. The first set of studies aimed to explore the modal number, i.e., how many systems can a single operator supervise and control. It was found that an experienced operator can supervise up to 15 UASs efficiently using moderate levels of automation, and control (mission and payload management) up to 3 systems. Once this limit was reached, a single operator’s performance was compared to a team controlling the same number of systems. In general, teams led to better performances. Hence, shifting design efforts towards developing tools that support teamwork environments of multiple operators with multiple UASs (MOMU). In MOMU settings, when the tasks are similar or when areas of interest overlap, one operator seems to have an advantage over a team who needs to collaborate and coordinate. However, in all other cases, a team was advantageous over a single operator. Other findings and implications, as well as future directions for research are discussed.

<http://journal.frontiersin.org/article/10.3389/fpsyg.2016.00568/abstract>

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### **Robot Brains Where & When You Want ‘Em**

DARPA Persistent Close Air Support (PCAS) system by Raytheon

Classic science fiction imagined evil master computers remote-controlling their mindless robot minions. It imagined good-guy droids that were basically humans in tin suits. But as the actual science of autonomy evolves, reality is looking a lot weirder.

The user interface may be in an ordinary Android tablet, but the artificial intelligence itself may reside in a pod under an airplane’s wing, in a ground station directing a distant drone or in a processor strapped to a soldier. Or the electronic brain maybe everywhere and nowhere at once, with the tasks of thinking distributed across multiple locations in a network. That flexibility is central to Deputy Defense Secretary Bob Work’s vision of the Third Offset Strategy, in which artificial intelligence and human creativity combine, like a centaur, to create an enduring technological advantage for US forces.

We're "developing different autonomy services that can be hosted at different locations," said Raytheon senior engineering fellow David Bossert. Using Defense Department open standards and a "service-oriented architecture," the overall autonomy package consists of multiple optional modules that can be tailored to the mission and the platform. The user gets information and issues commands with an Android, but the interface software on the tablet can be either the Air Force-developed Android Tactical Assault Kit (ATAK) or the Marine Corps KILSWITCH .

That approach allowed Raytheon to port its Persistent Close Air Support (PCAS) software from an Air Force jet to a Marine tilt-rotor, an Army helicopter, and ultimately an Unmanned Aerial Vehicle, he said. "Even though we had some of the PCAS services on an A-10 and then a MV-22 and an AH-64, we were able to take them and put them on a UAV," Bossert told me. Now Raytheon is re-repackaging PCAS for the infantry as part of DARPA's Squad-X program.

On the A-10, the PCAS computer and its communications kit were housed in a pod under the wing. There wasn't room to do that on the much smaller MQ-1C Grey Eagle, the Army variant of the famous Predator, Bossert said, so "all the autonomy and computing resources [were] hosted in the ground control stations." In Squad-X, he continued, "each soldier will have a processor," as well as each Unmanned Ground Vehicle (UGV).

#### DARPA Squad-X focus areas

Such distributed systems will be particularly useful for the DARPA Squad-X initiative, which aims to bring the information age — networks, smart weapons, robotics — to the blood-and-mud world of the infantry squad. Raytheon is handling the autonomy portion of the project. It would be horrendously impractical to have one big computer brain in a pod or control station. How would the squad carry it? Where would they plug it in? So Squad-X will use lots of little brains, linked together as one mind via radio in a wireless network, building on current Army systems like Nett Warrior.

That network will be designed to be resilient against hacking, jamming, and mundane interference, Bossert said, but the software has to keep working even when the network goes down. One lesson from the PCAS project is "it's not if the radio drops out, it's when the radio drops out," he said. "I'm going to lose comms when I least expect it."

Raytheon isn't just applying the lessons of PCAS to Squad-X: It's actually building its software for the one on the foundation of the other. Both are DARPA projects involving autonomy, but the details were very different.

For PCAS, said Bossert, "our only metric [of success] was to decrease the timeline for Close Air Support [CAS] from about 30 minutes, [given] an A-10 that was 20 nautical miles away... down to six minutes or less," which essentially is the time it took the A-10 to cover the 20-mile distance. The PCAS software streamlined the process of calling in an airstrike to the point where all the planning was done during that six-minute transit. The software transmitted target information from the forward observer to the pilot, outlined a route for the attack run, and suggested the best weapon to destroy the target with minimum collateral damage.

Squad-X is much more complex. First of all, for robots, operations on the ground — a cluttered, messy environment full of both stationary and moving objects — are much more complex than operations in relatively empty domain of air. Second, Squad-X envisions much more than calling in air support. Its software has to control mini-drones and Unmanned Ground Vehicles (UGVs), integrate data from long-range sensors, and update soldiers on the tactical situation and do it all without relying on GPS.

Just fusing all the disparate data can be tricky. A human driving a car and talking on a cellphone will show up on optical sensors, acoustic sensors, and radio-frequency sensors, for example, so you need software that can figure out all three contacts represent the same real-world object, not three different things. “There are lots of correlation engines out there that do pretty well,” said Bossert, but getting them to work in a realistic tactical environment is “going to be a big part of the experimentation.”

Then there’s the robotics aspect. Rather than remotely piloted robots like the Predator or bomb-squad bots, the Squad-X robots are supposed to figure out their own course of action in accordance with human commands. Those commands will initially be delivered over the Android but may one day come by voice and gesture. “Commercial industry’s helping us quite a bit” on this challenge, Bossert said, pointing to Google’s extensive work on self-driving cars.

Clearly there’s a tremendous amount of work to be done, but there’s tremendous potential as well. When it comes to unmanned systems, said the head of Raytheon’s advanced missile systems unit, Thomas Bussing, “we’re not technology-limited; we’re more comfort-limited.”

“The systems that we have today could do a lot more,” Bussing said, if we had the imagination and daring to exploit them.

<http://breakingdefense.com/2016/04/robot-brains-where-you-want-em-raytheon-on-autonomy/>

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## **Take Cover Against This Drone Attack**

If Congress lets the FAA override state or local laws, get ready to lose privacy and property rights.

By Troy A. Rule March 29/30, 2016 Wall Street Journal

The Senate Committee on Commerce, Science and Transportation approved a new FAA Reauthorization bill on March 16 that would drastically alter the evolution of the nation’s drone laws. Buried deep in the bill, Section 2142 would make the Federal Aviation Administration the nation’s sole drone regulator. If the provision is signed into law, drone operators with FAA authorizations will be free to ignore state and local drone-use restrictions. Landowners and local governments will have a difficult time keeping unwelcome drones out of backyards and neighborhoods.

The FAA and other supporters of Section 2142 argue that broad federal pre-emption is the only way to prevent a patchwork of local rules from crippling the burgeoning domestic drone industry. In reality,

Congress could easily draft language creating exclusively federal authority over only certain specific matters. It could expressly require the FAA to ensure, for instance, that drone operators in all 50 states refrain from flying drones near airports or important security sites or at altitudes where conventional aircraft fly. It could authorize the development of nationwide drone-identification and tracking systems. Federal drone-manufacturing standards could let companies mass produce drones eligible for sale in all the states.

However, many other aspects of civilian drone regulation involve questions that only states and local governments are equipped to address. For example, during what hours of the day should drone-assisted pizza deliveries be permitted in dense urban neighborhoods? Under what conditions should real-estate photographers in a beachfront community be permitted to use drones to capture aerial views of homes being listed for sale? Or how close to a suburban high school's football stadium should drone flying be allowed on game nights?

Centralized federal agencies are incapable of tailoring drone-use restrictions to fit the unique characteristics and preferences of every local jurisdiction. Given the obvious advantages of involving states and municipalities in the regulation of drones, why is Congress seriously considering statutory language that would effectively prohibit local drone-use restrictions?

The only legal protections available to citizens against these intrusions into what has long been regarded as private airspace would be through voyeurism statutes and fuzzy common-law theories such as "nuisance" that are difficult to establish and costly to enforce.

Section 2142 has more to do with federal overreach and corporate advantages than with preventing patchworks of state and local drone laws from thwarting the efficient growth of a nascent industry. That is why the National Conference of State Legislatures, the National League of Cities and the U.S. Conference of Mayors sent letters to heads of the Senate Committee on Commerce, Science and Transportation on March 15 urging them to strike Section 2142 from the reauthorization bill.

Senators now have a distinct choice to make: They can vote to preserve local autonomy and the legitimate interests of homeowners, or they can effectively transfer millions of dollars in airspace-related rights to a handful of behemoth corporations. If recent history is any indication, it may be wise to wear earplugs and full-coverage swimsuits to next year's backyard pool party. The forecast calls for drones.

Mr. Rule is a law professor at Arizona State University's Sandra Day O'Connor College of Law.

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**UPCOMING EVENTS:**